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SANITARY DISPOSAL OF SEWAGE THROUGH A SEPTIC TANK.

A System of Simple Construction and Inexpensive Operation for Isolated Dwellings.[1]

By H. R. Crohurst, Associate Sanitary Engineer, United States Public Health Service.

In view of the frequent requests for a detailed description of practicable and economical methods of sewage disposal for the isolated home or the small group of homes supplied with running water and provided with toilet, sink, and bath fixtures, the following data are presented.[2]

In 1910, or about that time, the State board of health of New Hampshire was called upon to devise a practicable and sanitary method of sewage disposal for single residences, summer cottages, and hotels. As a result there has been developed by Robert Fletcher, D. Sc., C. E., president of the State board of health, the so-called "Free-flowing, tight, sewage tank," which, during the past 10 years, has been in successful operation, under varying conditions, in several hundred locations in that State.

The design, as now recommended by the State board, consists of a rectangular tank, built of concrete, without baffles, with a relatively tight-fitting cover and without ventilation. A space of from 12 to 15 inches is provided between the under side of the cover and the surface of the sewage. The cover is made to fit as tightly as possible, in order that the gas given off during the septic action may develop a slight pressure in the dead space above the sewage and serve to exclude outside air. The inlet and outlet pipes of the tank are provided with elbows, which turn downward into the sewage and end well below the surface. Experience in New Hampshire has shown that a capacity of 4 cubic feet (30 gallons) should be allowed for each person contributing to the tank.

The smallest tank recommended is 6 feet long, 3½ feet wide, and has a depth of sewage of 4½ feet. Such a tank has a capacity of about 94 cubic feet (excluding dead space above sewage) and would effectively serve 20 persons. It is not deemed advisable to build a tank smaller than this. For larger installations the following sizes are recommended:

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[1] The material in this article has been obtained from the special bulletin, "Free-flowing, Tight, Septic Tanks," by Robert Fletcher, D. Sc., C. E., published by the State Board of Health of New Hampshire; from information obtained from Mr. D. M. Tefft, health officer of Sugar Hill, N. H., who has had 11 years' experience in the construction and operation of tanks of this type; and from an inspection made by the writer, of tanks in operation at Claremont and Sugar Hill, N. H.

[2] Editorial note.—The simple and inexpensive method of sewage disposal here described has operated successfully over a period of several years. The design of the tank and the methods of effluent disposal are similar to those described in Public Health Bulletin No. 101, "Studies of Methods for the Treatment and Disposal of Sewage," by Earle B. Phelps, Leslie C. Frank, and C. P. Rhynus. This bulletin contains an extensive discussion of various methods of sewage disposal for single houses and small communities, applicable to any part of the country.

Number of persons.	Length.	Width.	Depth of sewage.
	Feet.	*Feet.*	*Feet.*
One family (and up to 20 persons)	6	3.5	4.5
40 persons	8	4.5	5
60 persons	9	5	5
70 persons	11	5	5
150 persons	14	6	5.5
400 persons	24	8	7

The tanks should be located in the yard, as near the house as practicable, and should be buried in the ground and have a covering of 12 to 18 inches of soil. The temperature of house sewage combined with the heat generated by septic action helps to prevent freezing in winter.

As the effluent of a septic tank is only partially purified sewage containing organic matter which is potentially capable of causing objectionable conditions if not properly disposed of, and as it contains at all times many bacteria, among which may be those capable of causing disease, the proper disposal of septic-tank effluent is a matter of very great importance.

For the small installation subsurface irrigation seems to offer the easiest means of disposing of the tank effluent. Where the soil is porous and the seepage rapid, the effluent may be discharged into a leaching cesspool, blind drain, or subsurface tile system. The details of construction of the septic tank and various methods of effluent disposal, in a porous soil, are shown in Figure 1.

Where the soil is tight and does not allow the rapid passage of liquids, a filter trench may be required. This is constructed by laying two lines of tile, one above the other, in a trench or series of trenches, with an artificial filtering medium between the upper and lower line of tile. The tank effluent is distributed by the upper line of tile, trickles through the filtering material, and is collected in the lower line of tile, from which it may be discharged into an open ditch or into a watercourse. Where a filter trench is used for secondary treatment, there is usually, and always should be, provided a dosing chamber containing an automatic siphon, which collects the tank effluent and discharges it into the trench in a single large flush, thus utilizing the entire volume of the bed. A constant trickle from the tank overdoses a small portion of the trench. For larger installations where secondary treatment consists of sand filters, contact beds, or trickling filters, a dosing tank and automatic siphon are always needed. The construction details for a septic tank, dosing chamber with automatic siphon, and filter trench, are shown in Figure 2.

The sewer line from the house to the septic tank should not be less than 4 inches in diameter, preferably 6 inches, should have tight joints, and should have a fall of about 1 foot in 100 feet. The tank should be made of concrete, carefully constructed, and made watertight; and for large installations, reinforcing should be provided. The dosing chamber should have a capacity of about 80 gallons and should be equipped with a 3-inch automatic siphon. The tile lines should be 4 or 6 inches in diameter, laid with open joints, the upper portion of the opening being covered with tar paper, burlap, or old linoleum, to prevent soil from entering the line. The irrigation tiles should have a fall of about 2 or 3 inches per hundred feet. A mat of hay or straw laid over the tile lines and filter material serves to hold the back fill and prevent mud from entering when the ground is moist after rains. The first 10 to 15 feet between the tank and the irrigation system, or between the dosing chamber and the irrigation system, should have tight joints to prevent the effluent from soaking into the ground in the immediate vicinity of the tank.

The length of tile lines in the disposal system will depend upon the character of the soil in which the tile is laid. In a coarse sandy soil, 20 feet per person using the tank may be sufficient; whereas in a tight sandy clay soil, 100 feet or more per person may be required. Where a dosing chamber and siphon are used, the size of dose determines the length of tile lines required. The tile lines should have a capacity equal to or greater than the capacity of the dosing chamber. Assuming the capacity of the dosing chamber to be 80 gallons, there should be provided about 125 feet of 4-inch tile, or about 60 feet of 6-inch, to receive at once the entire flush when the dosing tank is emptied.

In outlining plans for the construction of septic-tank systems, it is the rule to recommend the installation of a grease trap between the kitchen fixtures and the septic tank, to remove grease from the sewage. In the New Hampshire system no grease trap is provided, and the tanks appear not to be affected by the presence of the grease in the sewage. To prevent trouble at times, it is advisable, however, to remove as much grease as possible from the kitchen wastes and dispose of it by some other method. All excess water which can be excluded conveniently should be excluded from the tank, as continuous flow, without quiescent periods, disturbs septic action.

The oldest New Hampshire tanks have now been in operation and successfully disposing of combined household wastes for a period of 11 years, and, so far, have never required cleaning. The effluent is relatively clear and odorless and in some instances has been disposed of by irrigation over the surface of the ground without offense; but this method from a sanitary standpoint is not recommended.

For the single residence or small group of homes, where a sewerage system is not practicable, it appears that a sewage-disposal system of this type offers a reasonably cheap and efficient method of dis-

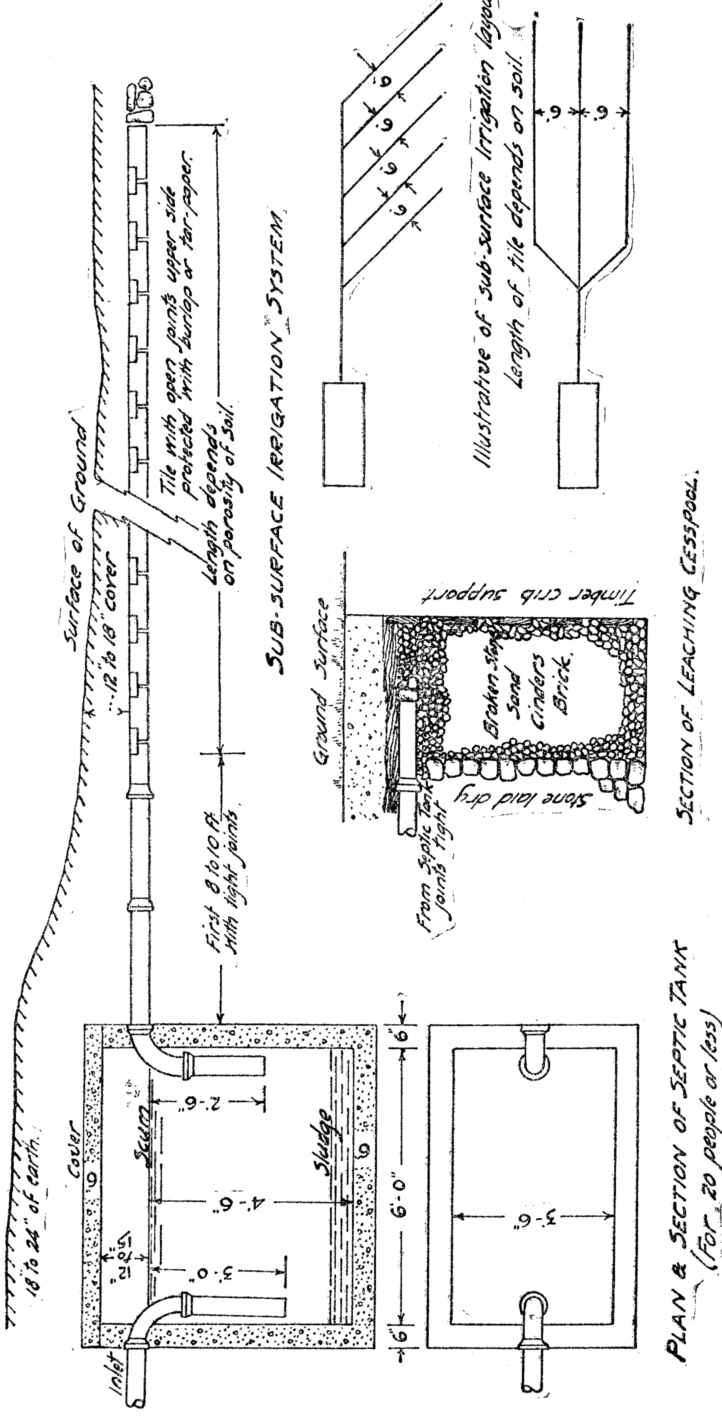
Surface of Ground
12 to 18" cover
18 to 24" of earth.
Cover
Inlet
12" to 15"
Scum
Sludge
2'-6"
4'-6"
3'-0"
6"
6'-0"
6"
3'-6"
PLAN & SECTION OF SEPTIC TANK
(For 20 people or less)
First 8 to 10 ft. With tight joints.
Tile with open joints upper side protected with burlap or tar-paper.
Length depends on porosity of Soil.
SUB-SURFACE IRRIGATION SYSTEM
6'
6'
6'
6'
6'
6'
Illustrative of sub-surface Irrigation layouts
Length of tile depends on soil.
Ground Surface
From Septic Tank joints tight
Broken Stone
Sand
Cinders
Brick
Timber crib support
Stone laid dry
SECTION OF LEACHING CESSPOOL

FIG. 1.

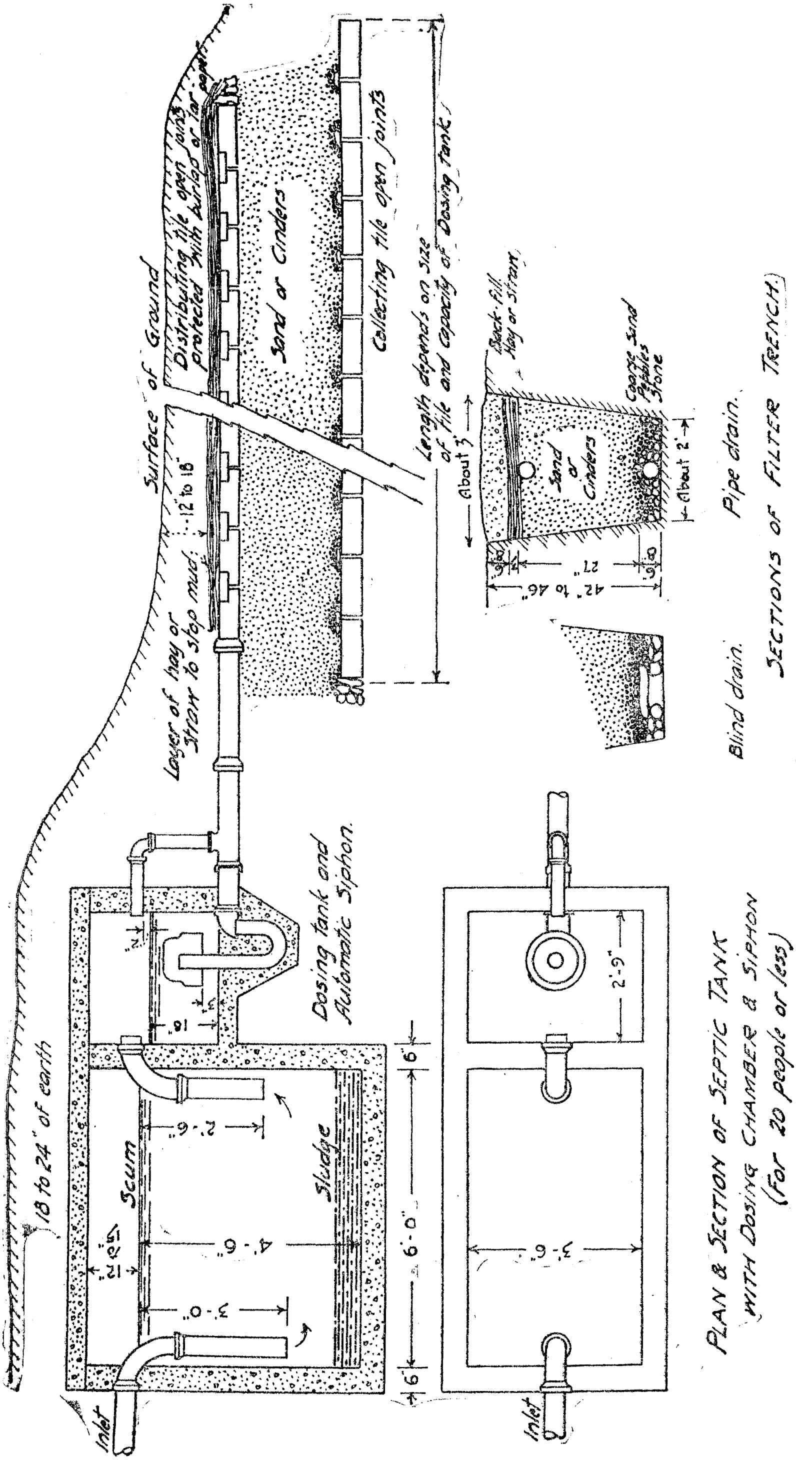
18 to 24" of earth
Inlet
Scum
Sludge
12"
3'-0"
4'-6"
2'-6"
6"
6'-0"
6"
18"
3"
2"
Dosing tank and Automatic Siphon.
3'-6"
2'-9"
Inlet
PLAN & SECTION OF SEPTIC TANK WITH DOSING CHAMBER & SIPHON (For 20 people or less)
Layer of hay or straw to stop mud.
12 to 18"
Surface of Ground
Distributing tile open joints protected with burlap or tar paper
Sand or Cinders
Collecting tile open joints
Length depends on size of tile and capacity of Dosing tank
Back-fill Hay or Straw
About 3'
Sand or Cinders
Coarse Sand Pebbles Stone
About 2'
8"
27"
8"
42" to 46"
Blind drain.
Pipe drain.
SECTIONS OF FILTER TRENCH.

FIG. 2.

posal and requires a minimum amount of supervision after installation. The successful operation of these tanks in New Hampshire suggests that similar results could be obtained in other sections of the country having comparable climatic conditions. The successful operation of a system of this type in sections having summer temperatures much higher and of longer duration can not be definitely stated before a study of installations under such conditions has been made; but it appears probable that this system will give results in the southern sections of the United States similar to those given by it in New Hampshire.

Before installing a system of this kind in any locality, especially in limestone sections of the country, the opinion of the State health authorities should first be obtained as to whether the character of the soil is such that would permit of the operation of the system without danger, owing to the seepage of the partially purified sewage through voids.

THE BEDBUG.

Its Relation to Public Health, its Habits and Life History, and Methods of Control.

The bedbug is one of the numerous insects which have been suspected of conveying disease to man. Compared with such insect pests as mosquitoes, lice, and fleas, however, its rôle is decidedly a minor one. It has been claimed that the bedbug can take up the microparasites of European relapsing fever, plague, and possibly leprosy, along with the blood of men or animals suffering from these diseases. It is also possible that in rare instances the bedbug may transmit plague or European relapsing fever to man. On the other hand, there is no convincing evidence that the bedbug is the usual and ordinary insect transmitter of these or any other diseases at present known to us.

If the bedbug acts as a transmitter of disease, it apparently does so by the accidental carriage of disease elements on the mouth parts; but this occurs only under the most favorable conditions. These would require, first, the presence of great numbers of microparasites on the skin or in the blood of a man or animal sick with some disease transmissible to man by subcutaneous inoculation; second, it would probably be necessary that there should be many bugs biting in order that one or more of them should bite some healthy person within a rather short space of time after these insects had fed on the infected individual.

In actual practice these conditions would be found only in the most filthy and insanitary surroundings and would call for drastic measures to exterminate all vermin. It is, of course, possible that under unsettled conditions where sick and well are crowded together